

# INTEGRATED PEST MANAGEMENT

## Yield and Botanical Composition of Rhizoma Peanut-Grass Swards Treated with Herbicides

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### ABSTRACT

Weeds are an increasing problem in rhizoma peanut (RP) (*Arachis glabrata* Benth.), a warm-season perennial forage legume. The objective of this field study was to measure the effect of glyphosate [*N*-(phosphonomethyl)glycine] at 1.12, 2.24, or 3.36 kg a.i. ha<sup>-1</sup> and triclopyr [(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid at 0.56, 1.12, or 1.68 kg a.i. ha<sup>-1</sup> applied in the summer on dry matter (DM) yield and botanical composition of weed-infested RP-grass swards at 2 and 4 mo after application. Mexican-tea (*Chenopodium ambrosioides* L.) and cogongrass [*Imperata cylindrica* (L.) P. Beauv.] were the most common weeds. Glyphosate, at all rates, reduced Mexican-tea DM 2 mo after application in both years. However, substantial recovery of existing MT plants was observed 4 mo after application at all but the high rate. Glyphosate had no effect on cogongrass or other grasses in 1995 or 1996. In both years, rhizoma peanut DM declined as the rate of glyphosate increased. Some recovery of RP was noted at the low (1.12 kg ha<sup>-1</sup>) rate of glyphosate by 4 mo after application. Edible DM (RP + other grasses) was reduced due to glyphosate treatment only at the high glyphosate rate. In both years, triclopyr was effective in reducing Mexican-tea DM 2 mo after application with limited recovery of treated plants 4 mo after application. Cogongrass and other grasses increased in the triclopyr treatments in both years, possibly due to reduced competition from Mexican-tea. Rhizoma peanut DM decreased as the rate of triclopyr increased in 1995 at 2 and 4 mo after application, but this effect was observed only at 2 mo after application in 1996. Triclopyr application had little effect on edible DM, but this was a consequence of the substitution effect of other grasses for RP. Both triclopyr and glyphosate can be useful in weed-infested RP stands, but glyphosate at the rates tested was not as effective as triclopyr in controlling Mexican-tea.

RHIZOMA PEANUT is a warm-season perennial forage legume with exceptional forage quality, high biomass production, long-term persistence, and multiple uses (Williams et al., 1991; Ortega-S. et al., 1992; French et al., 1994). In subtropical Florida, RP provides herbage for grazing from April to October or two to three hay harvests per year. There are more than 8000 ha in full production in Florida (Quesenberry, 1999).

Invasion of weeds into RP-grass swards has recently been documented (Williams, 1994). Rhizoma peanut-grass swards have not shown any apparent decline in RP contribution (Williams et al., 1991); however, pasture botanical surveys have shown a negative correlation

between the presence of grass and weedy forbs in RP-grass swards (Harrelson et al., 1993).

In Florida, high summer rainfall and mild winter temperatures provide a favorable environment for perennating Mexican-tea plants which can reach a height of 1.5-m each summer and dominate RP-grass swards. Cogongrass, widely regarded as an invasive weed, is also favored by these growing conditions (Dozier et al., 1998). This perennial grass has invaded large areas of pasture and forestland in the state and is widespread along roadsides. Encroachment of these weeds on RP-grass swards represent a problem for hay producers and graziers. Weeds compete directly with desirable forage species for water, light, and nutrients and reduce both the nutritional and dollar value of the hay. The vigorous growth and unpalatable nature of these weeds makes them difficult to control with grazing management alone (Valencia et al., 1999).

Strategic use of herbicides to minimize weed impact and increase edible forage has not been assessed in RP-grass swards. Glyphosate [*N*-(phosphonomethyl)glycine] and triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid) are both herbicides registered for use in pastures. Glyphosate is a systemic broad-spectrum herbicide that is foliarly absorbed but inactive in soil. Triclopyr is a systemic broadleaf herbicide that is foliarly absorbed and degrades in soil in 20 to 40 d by microbial activity (Ware, 1989). Fully established stoloniferous perennial peanut (*A. pinto* Krapov & W.C. Greg.) was found to be tolerant of glyphosate (Dwyer et al., 1989). Glyphosate has been reported to substantially reduce cogongrass infestations, but required multiple applications during the growing season (Dozier et al., 1998). Triclopyr at a 0.56 kg ha<sup>-1</sup> controlled sand blackberry (*Rubus cuneifolius* Pursh) in bahiagrass (*Paspalum notatum* Flüggé) pastures, reducing its cover by 58 percentage units (Kalmbacher and Eger, 1994).

The reduction or response of weeds and rhizoma peanut DM to glyphosate and triclopyr are unknown. The objective of this study was to determine the effect of glyphosate or triclopyr applied at three rates during the summer on DM yield and botanical composition of weed-infested RP-grass swards.

### MATERIALS AND METHODS

This experiment was conducted in 1995 and 1996 at separate sites at the USDA-ARS Subtropical Agric. Res. Stn. in Brooksville, FL (28°37' N, 82°22' W), on a Nobleton fine

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sand (clayey, mixed, hyperthermic Aquic Arenic Paleudults). Experiments were located in RP-mixed grass stands that were more than 10 yr old. Mexican-tea was the most common weed in the pasture both years. Other minor weed species contributing to the sward included blackberry and annual sedges (*Cyperus* spp.), but these were not abundant enough to determine herbicide efficacy. The most common grasses included cogongrass and the forage grasses bahiagrass and common bermudagrass [*Cynodon dactylon* (L.) Pers.].

Herbicide treatments were applied on 30 June 1995 and 21 June 1996 to plots (3 by 7.6 m). Treatments included an unsprayed control, a low, medium, and high rate of glyphosate (1.12, 2.24, and 3.36 kg a.i. ha<sup>-1</sup>), and a low, medium, and high rate of triclopyr (0.56, 1.12, and 1.68 kg a.i. ha<sup>-1</sup>). Herbicides were applied using a CO<sub>2</sub>-pressurized backpack sprayer with a hand-held boom (2.5 m wide, nozzle spacing 50 cm) equipped with 11 003 flat-fan nozzle tips delivering 215 L ha<sup>-1</sup> at 276 kPa pressure.

Herbage mass was determined at 2 and 4 mo after herbicide application each year. At the first harvest, plots were divided into two subplots (3 by 3.8 m), one of which was harvested at 2 mo and the other subplot at 4 mo after application. Plots were harvested to a 2.5-cm stubble height using a sickle-bar mower. A 0.9- by 2-m strip was cut from the center of all harvested subplots. Two subsamples (approximately 400 g each) were taken, one for determination of DM concentration (dried to constant weight at 60°C) and the other for determination of botanical composition. Botanical composition subsamples were separated into Mexican-tea, cogongrass, other grass (sedges and grasses other than cogongrass), and RP fractions and were dried at 60°C.

Treatments were arranged in a randomized complete block design and replicated six times. Data were analyzed as a split-strip model using the GLM procedure of SAS (1989) with replicate and its interaction terms considered random. In the first analysis, year was included in the model as a main plot.

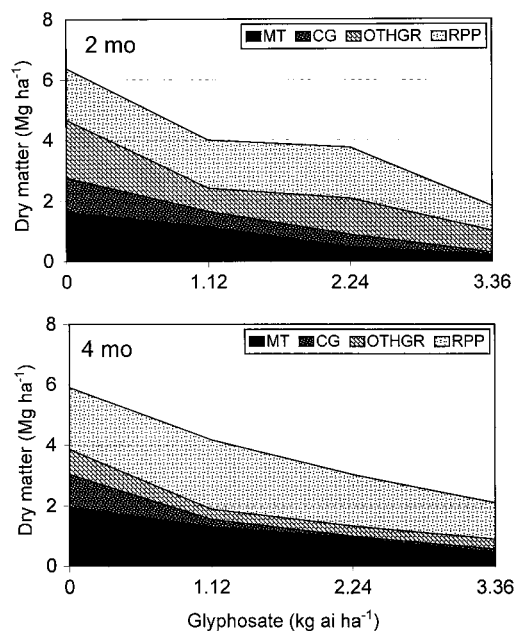


Fig. 1. Effect of glyphosate rates on dry matter (DM) yield of Mexican-tea (MT), cogongrass (CG), other grasses (OTHGR), and rhizoma peanut (RP) at 2 and 4 mo after application in 1995. At 2 mo (LSD<sub>0.05</sub>: MT = 0.6, CG = 2.0, OTHGR = 1.3, and RP = 0.6) and 4 mo (LSD<sub>0.05</sub>: MT = 0.8, CG = 2.3, OTHGR = 1.4, and RP = 0.8) after application, the effect of glyphosate rate on DM yield was linear for both MT ( $P < 0.01$ ) and RP ( $P = 0.03$ ).

There were significant year  $\times$  treatment  $\times$  harvest date interactions, so data were sorted by year and reanalyzed as a strip-plot model. In this analysis, herbicide treatment  $\times$  replication interaction was the error term for testing herbicide treatment, and harvest date  $\times$  replication was the error term used to test harvest date. Residual error was the error term for testing treatment  $\times$  time of harvest interaction. Treatment comparisons were made using single degree of freedom contrasts for linear, quadratic, and cubic effects of each herbicide. The control treatment was used as the zero rate for both herbicides.

## RESULTS AND DISCUSSION

### Glyphosate Effects

In both years, there was a treatment  $\times$  time of harvest interaction ( $P < 0.01$ ) for most response variables, so data were analyzed by time of harvest. When measured 2 mo after application in 1995, Mexican-tea DM decreased linearly ( $P < 0.01$ ) with increasing rates of glyphosate (Fig. 1). At the high rate, there was an 86% reduction in Mexican-tea DM relative to the control. At 2 mo after application (Fig. 2) in 1996, however, there were linear and quadratic effects ( $P < 0.01$ ) with most of the decrease in Mexican-tea DM occurring between zero and the low rate of glyphosate (5.3 to 1.60 Mg ha<sup>-1</sup> for zero and low rates, respectively). This represented a 70% reduction in Mexican-tea DM, while the medium and high rates resulted in 88 and 94% reductions, respectively, from that of the control.

At 4 mo after application in 1995, a linear effect ( $P < 0.01$ ) of herbicide rate was still observed on Mexican-

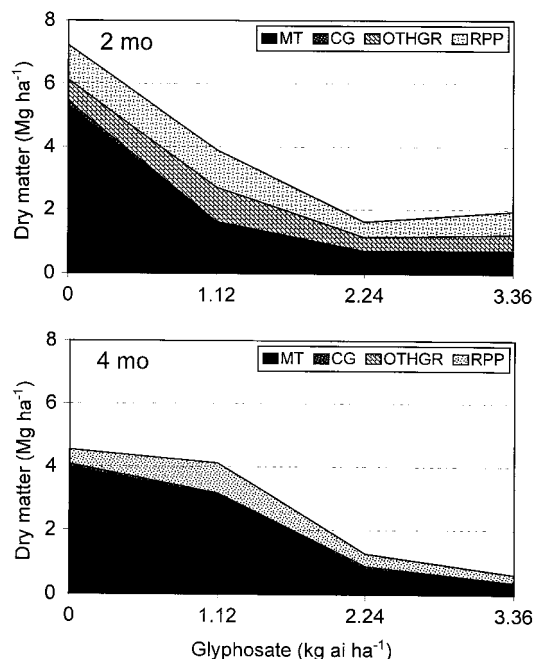


Fig. 2. Effect of glyphosate rates on dry matter (DM) yield of Mexican-tea (MT), cogongrass (CG), other grasses (OTHGR), and rhizoma peanut (RP) at 2 and 4 mo after application in 1996. At 2 mo after application (LSD<sub>0.05</sub>: MT = 1.2, CG = 0.7, OTHGR = 1.4, and RP = 0.4), the effect of glyphosate on DM yield was linear and quadratic ( $P < 0.01$ ) for MT and linear and cubic ( $P < 0.01$ ) for RP. At 4 mo after application (LSD<sub>0.05</sub>: MT = 1.2, CG = 1.0, OTHGR = 0.7, and RP = 0.5), the effect of glyphosate on DM yield was linear ( $P < 0.01$ ) for MT and cubic ( $P = 0.04$ ) for RP.

tea DM (2.0 and 1.0 Mg ha<sup>-1</sup> for zero and high rates). Some recovery of Mexican-tea was noted at all rates (1.30, 0.94, and 0.95 Mg ha<sup>-1</sup> for low, medium, and high, respectively); the maximum reduction in Mexican-tea DM at that time was 50% for the high rate compared with the unsprayed control (2.0 Mg ha<sup>-1</sup>).

Most of the DM increase between 2 and 4 mo after application in 1995 was due to recovery of existing plants and not from seedling emergence. Campbell et al. (1991) noted that the glyphosate rate of 1.8 kg a.i. ha<sup>-1</sup> was effective in controlling a perennial forb, St. John's wort (*Hypericum perforatum* L.), but that this plant recovered when lower rates (0.9 kg a.i. ha<sup>-1</sup>) were applied. Recovery of Mexican-tea at all rates suggest that more than a single application of glyphosate will be required to minimize Mexican-tea invasion in RP-mixed grass swards.

As in 1995, there was a linear effect ( $P < 0.01$ ) of herbicide rate on Mexican-tea DM (4.0 and 0.40 Mg ha<sup>-1</sup> for zero and high rates, respectively) at 4 mo. In contrast to 1995, most of the recovery between 2 to 4 mo after spraying occurred at the low rate of glyphosate (4.0, 3.0, 0.80, and 0.40 Mg ha<sup>-1</sup> for unsprayed, low, medium, and high, respectively). Reduction in Mexican-tea DM at 4 mo after spraying in 1996 was 88 and 90% for the medium and high rates, respectively. Environmental factors such as rainfall in the summer may have influenced herbicide efficacy. Rainfall occurred the afternoon after herbicide application in 1995, but there was no rain on the day herbicides were sprayed in 1996. This probably explains why the low rate of glyphosate was much more effective at 2 mo after application in 1996 than 1995 (Fig. 2). Lodge et al. (1994) noted that rainfall before and after herbicide application is an important factor determining the rate of herbicide recycling within the plant, the movement of herbicide to the root zone, and loss of herbicide by runoff.

There was no effect of glyphosate on cogongrass or other grasses in the sward at 2 or 4 mo after spraying in 1995 (Fig. 1) and 1996 (Fig. 2). Dozier et al. (1998) reported that applications of glyphosate in the fall were more effective (80%) than summer applications (40% control) for control of cogongrass. They attributed this to better translocation to belowground storage. Similar effects of glyphosate were observed on johnsongrass [*Sorghum halepense* (L.) Pers.], another perennial rhizomatous weedy grass (Lodge et al., 1994). The effect of glyphosate applications in the fall on cogongrass, other grass, and RP components should be assessed.

There was a linear effect ( $P = 0.02$ ) of glyphosate rate on rhizoma peanut DM at 2 mo after application in 1995 (1.7 and 0.81 Mg ha<sup>-1</sup> for zero and high rates, respectively). Compared with the untreated control, the phytotoxic effect on RP was still evident at 4 mo after spraying, although some recovery had occurred. Rhizoma peanut DM at the low rate 4 mo after spraying (2.30 Mg ha<sup>-1</sup>) was higher than at 2 mo after spraying (1.60 Mg ha<sup>-1</sup>). In contrast to 1995, in 1996 rhizoma peanut DM showed linear and cubic effects ( $P < 0.01$ ) at 2 mo and a cubic effect ( $P = 0.04$ ) at 4 mo after application in 1996. Rhizoma peanut DM at the medium

rate (0.50 Mg ha<sup>-1</sup>) was lower than at the high rate (0.70 Mg ha<sup>-1</sup>) 2 mo after application. Similar effects were observed at 4 mo after application.

Reductions in the DM of rhizoma peanut due to glyphosate applications were similar to what Argel and Valerio (1992) reported for *A. pintoii* after a single application of the broad-spectrum herbicide paraquat (1,1'-dimethyl-4,4'-bipyridium ion). The increase in rhizoma peanut DM observed at 4 mo after application indicates recovery of RP at the 1.12 kg a.i. ha<sup>-1</sup> rate. Although Mexican-tea control at the low glyphosate rate was not as effective as higher rates, it is possible that a single application of glyphosate in early spring, when MT is not as mature, may give better control at lower rates. This would also give enough time for RP to recover from the damage of summer grazing or hay harvest. Follow-up studies are necessary to evaluate spring applications and to assess the long-term effect of glyphosate on RP.

Unlike total DM in 1995, glyphosate treatment caused only slight declines in edible DM (other grass + RP) in 1995 (Table 1), and edible DM differed from the untreated control that year only at the high glyphosate rate. This was generally due to reductions in other grasses (Table 1), more so than the effect of glyphosate on RP at all except the high rate. In 1996, DM yield of both RP and other grasses also declined due to increasing rates of glyphosate, but these differences were not significant (Table 1). The fact that edible DM never increased due to glyphosate treatment suggests that the competitive effect of Mexican-tea was not so severe as to reduce yield potential of other grasses and RP. Similar animal performance reported in grazing trials conducted several years apart at this location on pastures that had been subject to increasing Mexican-tea encroachment, also suggests this may be the case (Williams et al., 1991; Harrelson et al., 1993). Fisher and Thornton (1989) suggest that this apparent lack of competition occurs when species do not strictly occupy the same space. Johnson et al. (1994) noted that, although RP is apparently tolerant of high levels of weed competition, RP production is reduced under high levels of shading. Further studies are needed on the economic threshold for herbicide application for controlling weeds in RP-grass swards for both grazing and hay production.

### Triclopyr Effects

There were linear and quadratic effects on Mexican-tea DM at 2 ( $P < 0.01$ ) and 4 ( $P < 0.02$ ) mo after spraying in 1995 (Fig. 3). At 2 mo after spraying, Mexican-tea DM decreased from 1.60 to 0.30 Mg ha<sup>-1</sup> for zero and low rates, respectively, but there was no effect of increasing the triclopyr rate from low to high (avg. 0.30 Mg ha<sup>-1</sup>). Thus, there was no advantage to increasing rates of triclopyr for control of Mexican-tea. The change in Mexican-tea DM from the zero to the high rate represents an 81% reduction, and unlike glyphosate treatments in 1995, this reduction represents the death of a large percentage of Mexican-tea plants. Similar effects were still present at 4 mo after spraying, with



**Table 1.** Effect of glyphosate and triclopyr on total dry matter (DM), edible DM (rhizoma peanut + other grasses), and DM yield of rhizoma peanut and other grasses for two years in subtropical Florida.†

Herbicide treatment	1995				1996			
	Total DM	Edible DM	Rhizoma peanut	Other grasses	Total DM	Edible DM	Rhizoma peanut	Other grasses
kg a.i. ha <sup>-1</sup>	kg ha <sup>-1</sup>							
<b>Glyphosate</b>								
0	6846	3229	1876	1353	5979	1121	788	333
1.12	4239***	2471	1923	548*	4240**	1619	1069	550
2.24	3532***	2450	1682	767	1621***	643	425	217
3.36	2743***	1537***	1013*	524*	1569***	728	489	238
<b>Triclopyr</b>								
0	6846	3229	1876	1353	5979	1121	788	333
0.56	4808***	3214	929**	2248**	3219***	1547	549	997
1.12	6316	3203	772**	2431**	3055***	2040	427	1613***
1.68	5979	1712**	240**	1072	3244***	1768	225**	1543**

\*, \*\*, \*\*\* Significant at the 0.05, 0.01, and 0.001 probability levels, respectively, according to Dunnett's *t*-test.

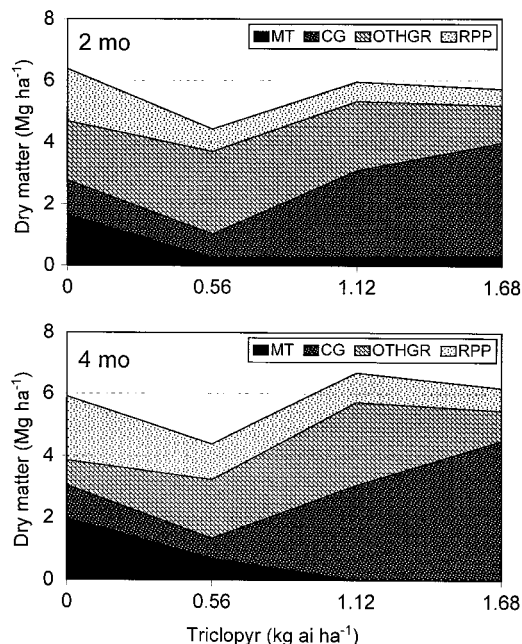
† Other grasses: sedges and grasses other than cogongrass.

only slight recovery of Mexican-tea evident at the low rate (0.30 vs. 0.68 Mg ha<sup>-1</sup> at 2 and 4 mo after application, respectively). Medium and high rates of triclopyr at 4 mo showed little evidence of regrowth, with close to 100% control.

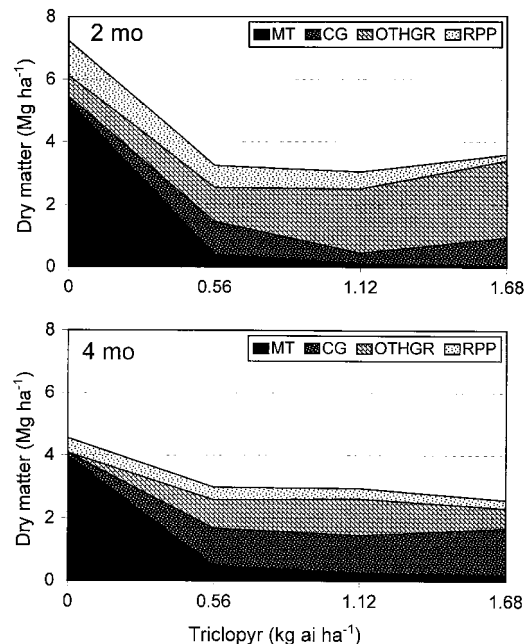
In 1996 (Fig. 4), there were linear and quadratic effects ( $P < 0.01$ ) of rate on Mexican-tea DM at 2 and 4 mo after spraying. The low rate reduced Mexican-tea DM by 92% (0.40 vs. 5.30 Mg ha<sup>-1</sup> for low vs. zero rates, respectively), and Mexican-tea DM varied little as rate increased from low to high (avg. 0.20 Mg ha<sup>-1</sup>)

at 2 mo after spraying. The average DM reduction across triclopyr rates was 97%. Similar to 1995, there was only slight recovery of Mexican-tea at the low rate (0.40 and 0.50 Mg ha<sup>-1</sup>, at 2 and 4 mo after application, respectively).

This study showed that a single 0.56 kg a.i. ha<sup>-1</sup> application of triclopyr was more effective in reducing Mexican-tea than glyphosate. The long-term effectiveness of a single 0.56 kg a.i. ha<sup>-1</sup> application of triclopyr on Mexican-tea is not known. Studies with other perennial broadleaf weed species have shown that more than one



**Fig. 3.** Effect of triclopyr rates on dry matter (DM) yield of Mexican-tea (MT), cogongrass (CG), other grasses (OTHGR), and rhizoma peanut (RP) at 2 and 4 mo after application in 1995. At 2 mo after application (LSD<sub>0.05</sub>: MT = 0.6, CG = 2.0, OTHGR = 1.3, and RP = 0.6), the effect of triclopyr on DM yield was linear and quadratic ( $P < 0.01$ ) for MT, linear ( $P < 0.01$ ) for CG, and linear ( $P < 0.01$ ) for RP. At 4 mo after application (LSD<sub>0.05</sub>: MT = 0.8, CG = 2.3, OTHGR = 1.4, and RP = 0.8), the effect of triclopyr rate on DM yield was linear ( $P < 0.01$ ) and quadratic ( $P = 0.02$ ) for MT, linear ( $P < 0.01$ ) for CG, quadratic ( $P < 0.01$ ) for OTHGR, and linear ( $P < 0.01$ ) for RP.



**Fig. 4.** Effect of triclopyr rates on dry matter (DM) yield of Mexican-tea (MT), cogongrass (CG), other grasses (OTHGR), and rhizoma peanut (RP) at 2 and 4 mo after application in 1996. At 2 mo after application (LSD<sub>0.05</sub>: MT = 1.2, CG = 0.7, OTHGR = 1.4, and RP = 0.4), the effect of triclopyr on DM yield was linear and quadratic ( $P < 0.01$ ) for MT, cubic ( $P = 0.01$ ) for CG, linear ( $P < 0.01$ ) for OTHGR, and linear ( $P < 0.01$ ) for RP. At 4 mo after application (LSD<sub>0.05</sub>: MT = 1.2, CG = 1.0, OTHGR = 0.1, and RP = 0.5), the effect of triclopyr rate on DM yield was linear and quadratic ( $P < 0.01$ ) for MT, linear ( $P = 0.01$ ) for CG, and linear ( $P = 0.05$ ) and quadratic ( $P = 0.01$ ) for OTHGR.

application of triclopyr is required to reduce infestations to an acceptable level (Campbell et al., 1991; Kalmbacher and Eger, 1994). In field plantings of RP–mixed grass, regrowth of Mexican-tea has been observed the year following triclopyr applications (M.J. Williams, personal observation). Follow-up studies should consider long-term efficacy of triclopyr on Mexican-tea populations.

In 1995 (Fig. 3), cogongrass increased linearly ( $P < 0.01$ ) with increasing rates of triclopyr (1.10 and 3.50 Mg ha<sup>-1</sup> for zero and high rates, respectively) at 2 mo after spraying. In contrast to 1995, at 2 mo after spraying in 1996 (Fig. 4) there was a cubic effect ( $P < 0.01$ ) of triclopyr rate on cogongrass DM. Cogongrass DM increased as triclopyr rate increased from 0 to 0.56 kg a.i. ha<sup>-1</sup>, decreased slightly with the medium rate and increased again at the high rate. By 4 mo after spraying in both years, cogongrass DM increased linearly as triclopyr rate increased ( $P < 0.01$ ).

Dry matter production of other grasses in the sward after triclopyr application varied across years. In 1995, triclopyr had no effect on other grasses 2 mo after application, but at 4 mo DM of other grasses increased at the low and medium triclopyr rates but declined slightly at the high rate (quadratic effect,  $P < 0.01$ ). In 1996 at 2 mo after application, other grasses DM increased linearly ( $P < 0.01$ ) as triclopyr rate increased. By 4 mo after application that year, other grasses DM increased with the low rate of triclopyr, but it remained nearly constant thereafter (linear and quadratic effects,  $P < 0.05$ ).

This apparent stimulation of grass growth, particularly cogongrass, by triclopyr in both years most likely occurred because of reductions in competition from Mexican-tea and possibly RP (see below). For cogongrass, this result is the inverse corollary to current control strategies for this weed which combine herbicide applications to reduce the stand and the introduction of tall, rapid growing broadleaf plants to suppress the remaining cogongrass plants (Shilling et al., 1997). Thus, herbicide applications that reduce broadleaf weed competition may be desirable if the grasses present are such as will be utilized by grazing animals. This is not a desirable effect when an unpalatable grass such as cogongrass is present.

In general, results of this study support the negative correlation regarding the presence of broadleaf weeds and grasses in RP swards suggested by Harrelson et al. (1993). It appears, that unlike many temperate legume–grass associations under grazing (Hoveland, 1989), broadleaf weed encroachment is at the expense of the grass component in RP–grass associations. Fisher and Thornton (1989) suggest that for legumes to maintain a significant component of the sward they must have “a superior competitive advantage for some scarce resource in the environment.” In the case of RP–grass associations, N may be that scarce resource. Work by Valentim et al. (1986) showed that at least 56 kg ha<sup>-1</sup> of N was necessary to maintain grasses associated with RP under simulated hay production. In a companion study (Valencia et al., 1999), we found that spring appli-

cations of N fertilizer to RP–grass swards essentially doubled the spring DM production of associated grasses without affecting rhizoma peanut DM production.

In 1995 (Fig. 3), rhizoma peanut DM declined linearly ( $P < 0.01$ ) with increasing triclopyr rates at 2 mo after spraying, and there was a maximum DM reduction of 68% for the high rate (1.70 and 0.54 Mg ha<sup>-1</sup> for the zero and high rates, respectively). At 4 mo after application (Fig. 4), there was still a linear effect ( $P < 0.01$ ) of triclopyr rate on rhizoma peanut DM (2.0 and 0.74 Mg ha<sup>-1</sup> for zero and high rates, respectively). Some recovery of rhizoma peanut DM occurred on triclopyr-treated plots between 2 and 4 mo after spraying. Averaged over the three rates, rhizoma peanut DM was 0.60 and 0.90 Mg ha<sup>-1</sup>, at 2 and 4 mo after application, respectively. In 1996 (Fig. 4), unlike 1995, there was a linear decrease ( $P < 0.01$ ) in rhizoma peanut DM with increasing rates of triclopyr at 2 mo (1.10 and 0.20 Mg ha<sup>-1</sup> for zero and high rates, respectively) but no effect at 4 mo after spraying. At 4 mo after spraying, average rhizoma peanut DM for low, medium, and high rates was 0.30 Mg ha<sup>-1</sup>, compared with 0.50 Mg ha<sup>-1</sup> at the zero rate.

Evans et al. (1989) observed that phenoxy herbicides can cause yield reductions of up to 62% in subterranean clover (*Trifolium subterraneum* L.). Yield reductions in clover have been observed to vary from 16 to 71% between site and year (Dear and Virgona, 1996). Similar variation in year was observed in this study. Although rhizoma peanut DM declined with increasing rates of triclopyr at both 2 and 4 mo after spraying in 1995 (Fig. 4), this effect was only observed 2 mo after application in 1996. This may have been because of the lower rainfall in that growing season (274 vs. 67 mm for October 1995 and 1996, respectively). Growth of RP in control plots was negligible.

Similar to what was observed with glyphosate treatments, edible DM was less sensitive to triclopyr rate than total DM (Table 1). Edible DM was reduced ( $P < 0.05$ ) only by the high rate of triclopyr in 1995, but this was a consequence of the substitution effect of other grasses for RP at the low and medium rates of triclopyr (Table 1). Although the bermudagrass and bahiagrass that composed the majority of the other grass component in this study are consumed by grazing animals, the nutritional value of these grasses is much lower than RP. Prine et al. (1981) has shown that animal performance declines with increasing levels of grass in RP swards, particularly at stocking rates that do not allow much selective grazing. Thus the amount of edible grass deemed acceptable in RP–grass swards will depend on grazing management and nutrient requirements of the class of animal (e.g., mature brood cow vs. stocker calf) utilizing the pasture.

## CONCLUSIONS

These results show that both triclopyr and glyphosate can be useful for altering the botanical composition in weed-infested rhizoma peanut–grass swards, although single applications of glyphosate at the rates tested was

not as effective as triclopyr in controlling Mexican-tea. Triclopyr effectively reduced Mexican-tea DM in both years by more than 90%. Because these rates resulted in significant substitution of grasses for Mexican-tea, triclopyr may not be useful when undesirable grasses such as cogongrass are present. Additionally, because herbicide rates that were more effective against weeds also decreased rhizoma peanut DM, their use must be weighed against potential losses in long-term productivity of rhizoma peanut. Given the difficulty and the high cost of completely eliminating weeds with herbicides, periodically suppressing the weed population to an acceptable level may be a necessary compromise.

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